

# COMP26120 Lab 5

?

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## 1 Complexity Analysis

### 1.1 Iteration Sort

Best case scenario for insertion sort is to literally be given a sorted array, in which case the sort iterates all of the items, giving a time complexity of  $n$ ;

Worst case scenario happens when the array is sorted in reverse order. Then, we have to iterate all of the elements ( $n$ ), however with each of the bigger iterations, we have to have  $(1 + 2 + 3 + \dots + (n - 1))$  smaller iteration for the actual sorting. So when we combine the two we get:

$$n(1+2+3+\dots+(n-1)) = 1n+2n+3n+\dots+n(n-1) = 1n+2n+3n+\dots+n^2-n$$

which has  $n^2$  complexity

where  $x[i]$  represents the number of second for loops which need to be done for a particular element and  $x[i] \in [0 : n - 2]$

The average case scenario has the equation

$$n(x1+x2+x3+\dots+(n-Xn-1)) = x1n+x2n+x3n+\dots+n(n-Xn-1) = x1n+x2n+x3n+\dots+n2-(Xn-1)n$$

which still has  $n^2$  complexity This makes the insertion sort inefficient when dealing with large files.

### 1.2 Quick Sort

Best case scenario occurs when the partitions are evenly balanced and the pivot is right in the middle after partitioning.

In this case we have  $cn + cn/2 + cn/4 + cn/8 + \dots$  which has  $n \log_2 n$

Worst case senario occurs when the partitions are the most unbalanced (we have to partition every single element separately).  $cn + c(n-1) + c(n-2) + \dots + 2c$

The avarage case senario occurs when each pivot is between the  $1/4$  to  $3/4$  of the overall lenght with  $3/4$  of the elements on the right and  $1/5$  on the left of the pivot. Applyng this rule we get  $n \log_2 n$

## **2 Experimental Analysis**

In this section we consider the question

Under what conditions is it better to perform linear search rather than binary search?

### **2.1 Experimental Design**

### **2.2 Experimental Results**

## **3 Extending Experiment to Data Structures**

We now extend our previously analysis to consider the question

Under what conditions are different implementations of the dictionary data structure preferable?

## **4 Conclusions**